
Space Weather Technical Forecast

Issued on Tuesday, 16 July 2024 at 13:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: M-Class flares likely (R1-R2 radio blackouts).**Analysis of Space Weather Activity over past 24 hours**

Solar Activity: Solar activity has been Moderate, with the largest flare M3.6 at 16/0737 UTC originating from AR3753. There are now up to seventeen sunspot regions on the visible disc. The largest and most complex region remains AR3738, now approaching the western limb. It is getting difficult to assess as it approaches the limb, but appears to remain magnetically complex with up to two delta regions present. The next largest region is AR3751, in the southeast. This spot continues to develop, gaining penumbra and now with a delta region evident here. AR3753 in the northwest is in an inherently unstable somewhat north-south magnetically aligned configuration. AR3743 has a somewhat complex magnetic structure, with flux emergence to the rear of the trailing spots. Several other regions have been showing recent growth, but are largely magnetically simple at present.

Despite the number of sunspot regions, no Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, showed a CME arrival around 15/2150 UTC. Wind speed was at background levels throughout, but rose slightly after the CME arrival to around 360 km/s. The density was mostly average. The interplanetary magnetic field (IMF), Bt, was initially weak, becoming moderate from 15/2150UTC, before increasing to be mostly strong between 16/0330-1000 UTC with a peak of 17nT. The north-south variation was also varied weakly initially, becoming moderately southward directed after the CME arrival reaching -10nT, then becoming moderately northward directed after 16/0200 UTC. The phi angle was variable at first, becoming near neutral after the CME arrival. Geomagnetic activity was Quiet to Unsettled (Kp 1-3), with an Active (Kp 4) interval 16/0000-0300 UTC.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was at background levels. The 24-hour fluence was below Active, with 1.15e6 integrated pfu observed at 16/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are likely with a slight chance of isolated X-class flares, most likely from AR3738 and AR3751. This risk reducing through the second half of the period as AR3738 rotates around the southwest limb.

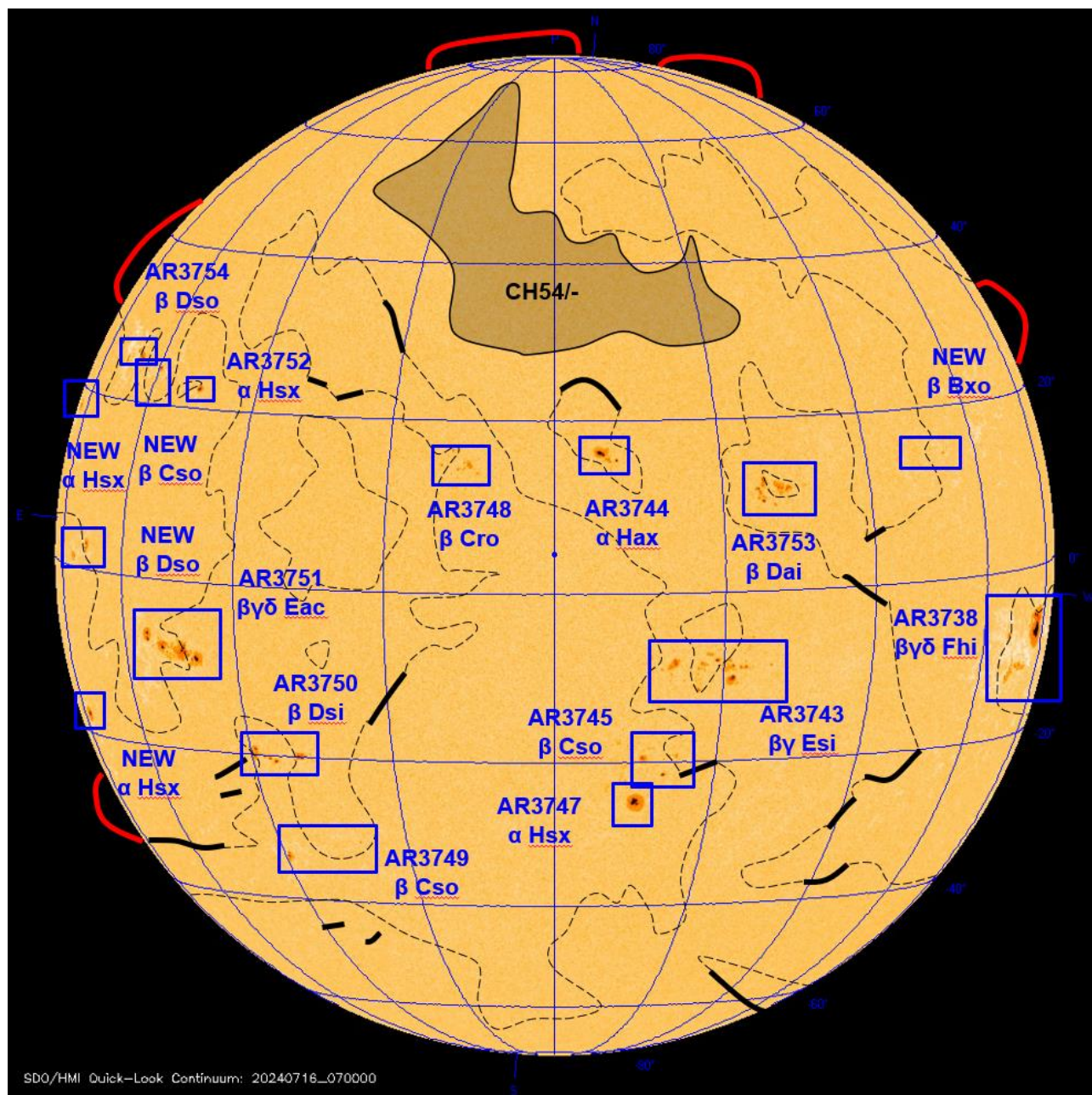
Solar Wind /Geomagnetic Activity: Earth currently appears to be experiencing the effects of a weak CME, but no other Earth directed CMEs are currently expected. The only other potential enhancement is that of CH54/- later in the period, but this is low confidence and solar winds are most likely to remain near background levels. Geomagnetic activity is expected to be mostly Quiet to Unsettled, with a slight chance of Active or G1/Minor storms on day 1 (16 Jul) due to the ongoing CME effects, then again on days 3 and 4 (18-19 Jul) should there be any fast wind enhancement.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels, but with a slight chance of rising above the S1/Minor Storm threshold in response to any notable flares, mainly from AR3738.

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The high energy electron flux is expected to remain at background levels. This may change should the onset of any fast wind occur around day 3 (18 July). Any uptick in fluence may be experienced from day 4 (19 Jul) onward, though the expectation is to remain below the Active threshold.

Figure 1. Solar Analysis Valid 16/0800 UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

Earth appears to be experiencing the effects of a weak CME, but no other Earth directed CMEs are currently expected.

The fast wind from CH54/- is something of an unknown as, although the CH was present on the last rotation, there was no obvious increase in wind speed from this feature. It is likely too far north to interact with Earth, though due to its size and apparent darkness, a token slight chance of a solar wind enhancement is catered for in days 3 and 4 (18-19 Jul). MOSWOC Enlil is almost anti-phase compared to expectations and very likely overstated in terms of magnitude.

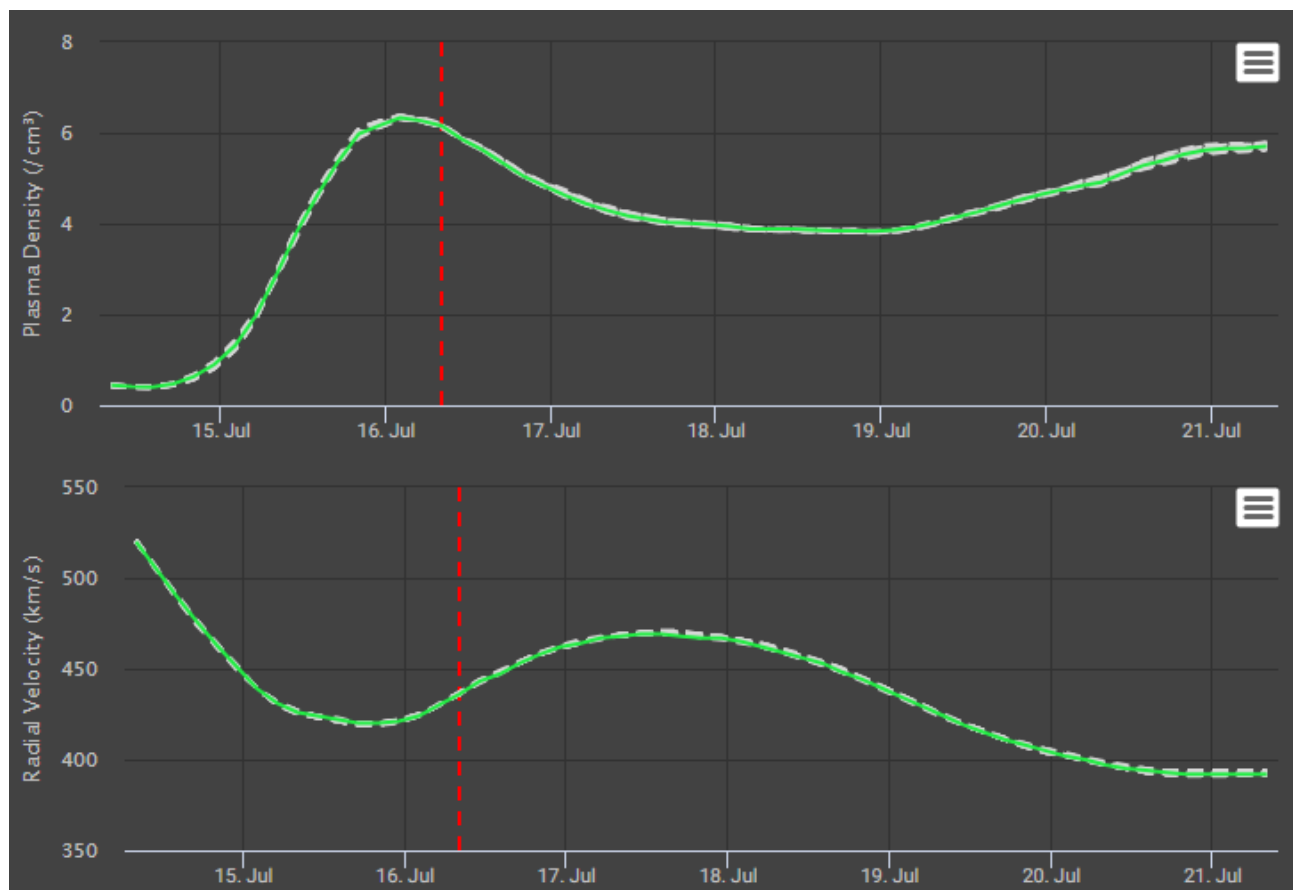
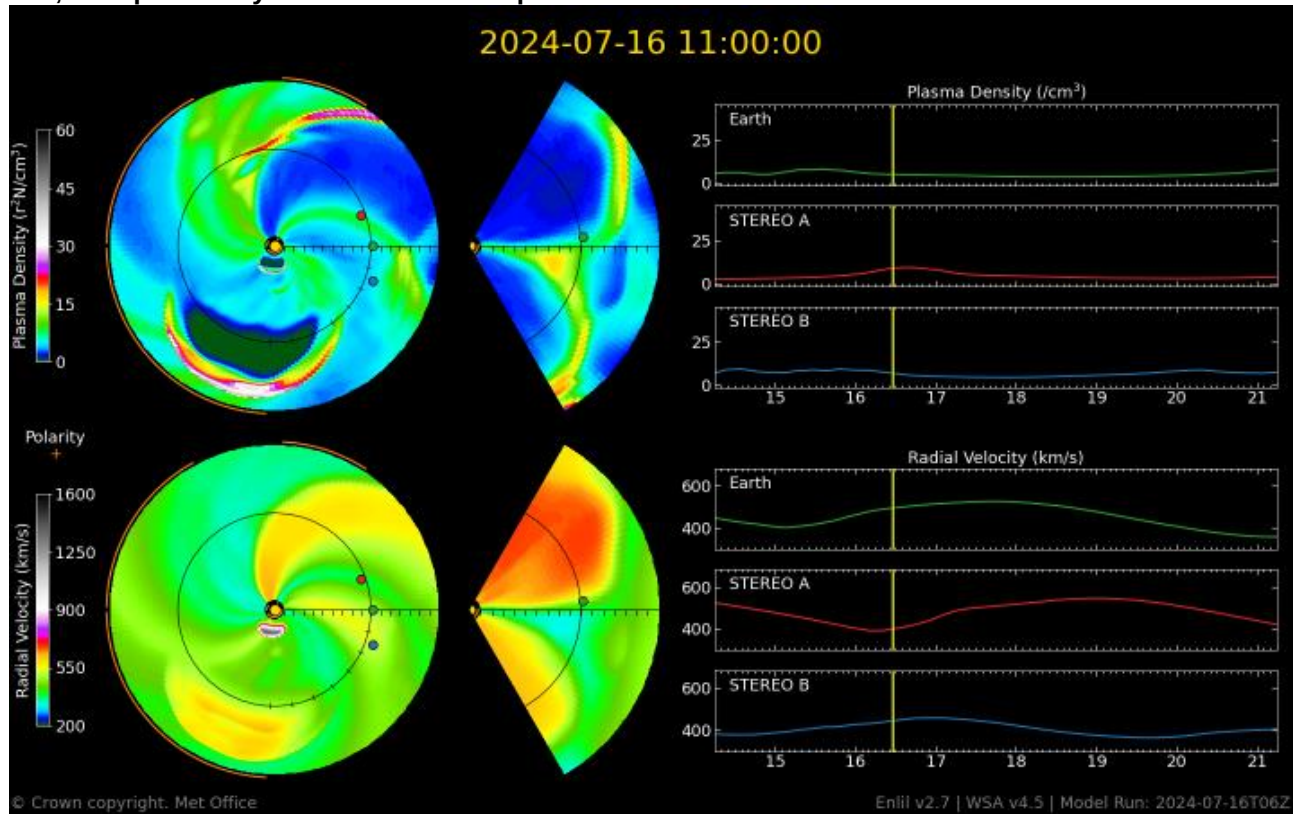
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Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	1	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs currently expected.

Figure 2: MOSWOC Enlil and ensemble, showing no Earth directed CMEs. Enlil does not seem to have captured the current solar wind correctly, and is too high with wind speeds in the next day or two, then potentially too low later in the period.



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Radio Blackouts - X-Ray Flares:

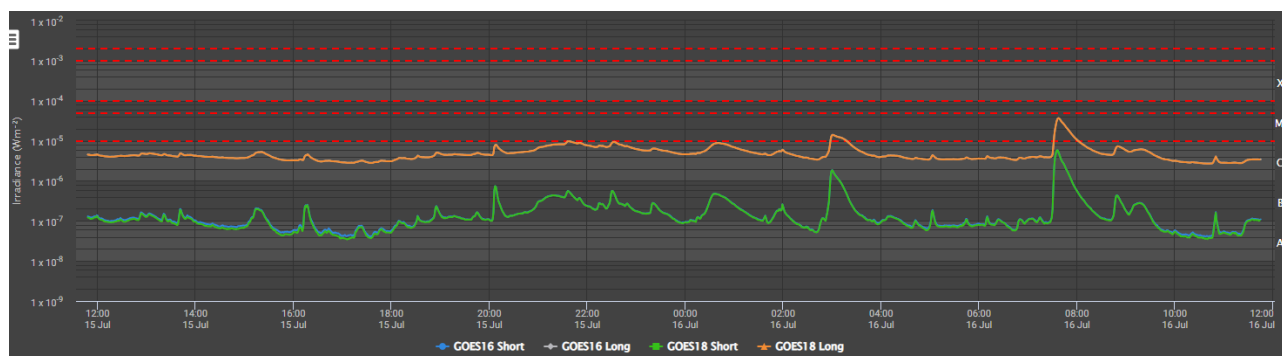
Solar activity has been Moderate, with the largest flare M3.6 at 16/0737 UTC originating from AR3753.

There are now up to seventeen sunspot regions on the visible disc. The largest and most complex region remains AR3738, now approaching the western limb. It is getting difficult to assess as it approaches the limb, but appears to remain magnetically complex with up to two delta regions present. The next largest region is AR3751, in the southeast. This spot continues to develop, gaining penumbra and now with a delta region evident here. AR3753 in the northwest is in an inherently unstable somewhat north-south magnetically aligned configuration. AR3743 has a somewhat complex magnetic structure, with flux emergence to the rear of the trailing spots. Several other regions have been showing recent growth, but are largely magnetically simple at present.

Further M-class flares are likely with a slight chance of an isolated X-class flare. The most likely candidates are AR3738 and AR3751 but isolated flares are also possible from elsewhere on the disc. This risk reducing through the second half of the period as AR3738 rotates around the southwest limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	60	60
Very Active	R3 to R5 X Class	No	10	10	5	5

Figure 3: X-ray flux at GOES16 and 18, showing recent M-class flares.



Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at background levels. There remains a daily slight chance of exceeding the S1/Minor radiation storm threshold should any significant flares occur from AR3738 which is in a good location at present for solar radiation events to connect with Earth. This risk will continue through the next few days until the region is well over the western limb.

Radiation Storms	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	15	15	15	10
Very Active	$\geq \text{S3}$ *	No	1	1	1	1

* $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)

High Energy Electrons Event ($\geq 2\text{MeV}$):

There are no immediate sources of fast wind enhancements, as such the high energy electron flux is expected to remain at background levels. This may change should the onset of any fast wind originating from CH54/- occur, but this is low confidence. Should it occur, it isn't due until at least day 3 (18 July) and therefore any uptick in fluence may be experienced from day 4 (19 Jul) onward, though the expectation is to remain below the Active threshold.

MOSWOC REFM runs are considered to be offering reasonable guidance in their continuing flat forecast trend.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM showing a flat fluence forecast through the next three days, which seems like good guidance.

